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A.D. 1898

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### PROVISIONAL SPECIFICATION.

#### Improvements in the Heating of Fluids.

I, ROBERT LUDWIG MOND, of 20, Avenue Road, Regents Park, in the County of London, Chemist, do hereby declare the nature of this invention to be as follows;—

My invention relates to the heating of fluids by means of suitable molten metal which is first heated by direct contact with flame and products of combustion and then is passed through the fluid which is to be heated.

By pumps or otherwise the metal after having parted with more or less of its heat to the fluid can be returned to be again heated and to operate again on the fluid.

In cases when the fluid to be heated and the heating metal might act chemically on each other, they may be separated by conducting metal, as in tubes or other passages exposing large surfaces.

Dated this 14th day of May 1898.

ABEL & IMRAY,  
Agents for the Applicant.

### 15 COMPLETE SPECIFICATION.

#### Improvements in the Heating of Fluids.

I, ROBERT LUDWIG MOND, of 20, Avenue Road, Regents Park, in the County of London, Chemist, do hereby declare the nature of this invention and in what manner the same is to be performed to be particularly described and ascertained in and by the following statement;—

In heating liquids for the purpose of generating steam or vapour, for distilling or concentrating, the heat is usually applied to the walls of the vessels containing the liquid or to the interior of tubes or conduits immersed in the liquid, and is communicated by conduction through the walls of the vessels or conduits. My invention relates to means of imparting heat to liquids in a more direct manner, by passing through the liquid to be heated molten metal or alloy which has been heated by direct action of flame and hot combustion gases upon the metal or alloy.

I select a metal or alloy which has a melting point below the temperature to which the liquid has to be heated; and a boiling point considerably higher than the temperature to which this metal or alloy has to be heated,—such for instance as Rose's or Wood's metal—so that, after passing through the heated liquid, the metal or alloy still remains in a liquid condition. The heating of the metal or

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*Mond's Improvements in the Heating of Fluids.*

alloy may be variously effected; according to one method I cause it to pass through a heating chamber containing pieces of metal or other refractory material arranged with interstices through which pass flame and hot furnace gases while the molten metal or alloy trickles over the pieces thus heated.

When the heated liquid is under pressure, as in the case of a steam boiler, the molten metal or alloy is forced or admitted by automatic feeders or other suitable appliances into the boiler, and, after passing through the water, it is discharged at the bottom under pressure so that it rises, or can be raised by pumping or otherwise, the heating chamber to be heated again and to be again forced or admitted into the boiler. As such a boiler is not heated from the outside, the walls of it can be made of any desired thickness, and steam of very high pressure can be obtained with perfect safety and very economically. In cases where the heated liquid is in open vessels as, for instance, when it is to be concentrated by evaporation, the heated molten metal or alloy descends through the liquid by gravity and, after being discharged at the bottom of the vessel it is raised by pumping or otherwise so as to be again heated, and to pass again through the liquid. 5 10 15

The metal or alloy selected for heating liquids as above described must be such that it has a boiling point above the temperature to which it is heated and that it does not chemically act or is not acted on by the liquid through which it is passed. 20

When hot gases or liquids which act chemically on the heated molten metal or alloy, are employed, it may be protected by separating it from contact with the gases or liquid by means of thin conducting material (preferably in the form of tubes) which is not chemically acted upon by the hot gases or liquids. 25

As it is necessary to maintain the metal or alloy in a fluid condition, the heating chamber and the liquid to be acted on and the vessel containing it are preferably heated in the first place, by any convenient means, to a temperature somewhat above the fusing point of the metal or alloy, which must itself be melted in the first instance. 30

For heating the fused metal or alloy, it should be distributed as completely as possible over the material in the heating chamber, and in applying it to heat liquid it should also be thoroughly distributed so as to pass in numerous small streams or drops through the liquid.

Having now particularly described and ascertained the nature of this invention and in what manner the same is to be performed, I declare that what I claim is;— 35

1. The herein described method of heating liquids by circulating a suitable molten metal or alloy first through an apparatus in which it is heated by direct contact with flame or hot gases and then through the liquid to be heated and back to be heated and operate again, and so on continuously. 40

2. The herein described method of raising steam or vapour under pressure by circulating a molten metal or alloy first through an apparatus in which it is heated by direct contact with flame or hot gases and then through the liquid to be vaporised contained in a closed vessel and back to be heated and operate again and so on continuously. 45

3. In the process for heating liquids or raising steam or vapour set forth in Claims 1 and 2, the use of a heated metal or alloy of a fusing point below the temperature to which the liquid is to be heated and of a boiling point above the temperature to which the metal or alloy is to be heated. 50

Dated this 10th day of February 1899.

ABEL & IMRAY,  
Agents for the Applicant.





